

SEQUENCE LISTING

<110> Tang, Maria
Sloma, Alan
Sternberg, David
Behr, Regine

<120> Methods For Producing Biological Substances In Pigment-Deficient Mutants Of Bacillus Cells

<130> 10302.200-US

<150> US 60/398,853

<151> 2002-07-26

<160> 31

<170> PatentIn version 3.2

<210> 1

<211> 1215

<212> DNA

<213> Bacillus subtilis

<400> 1

```
atgagccaat cgattaaatt gtttagtgtg ctttctgata aatttcaaaa caatccatat    60
gcttattttt cacaactgcg ggaggaagat ccggttcatt atgaagagtc gatagacagt    120
tattttatca gccgctatca tgatgtccgc tatatccttc agcatccgga tatcttcacg    180
acgaaatcac ttgttgagcg tgccgaacca gtcattgcgag gccctgtgct ggcccaaattg    240
catggaaaag aacactctgc caaaagaaga attgtagtga gaagctttat cggtgacgca    300
ctggatcatt tgtctccatt gattaaacaa aatgcagaaa acttgtttagc gccttatctt    360
gaaagagggg aaagtgatct cgtcaatgat tttggaaaga cgtttgcggt gtgcgtcacg    420
atggacatgc tcgggctgga taaaagagac catgaaaaaa tctctgagtg gcacagcgga    480
gttgccgatt ttatcacgag tatctctcaa tctcctgaag cgcgggcaca ttcgttatgg    540
tgcagcgaac agctttccca atacttgatg ccggtcatta aagaacgtcg cgtcaatccg    600
ggatcagatt taatttcgat cctatgtact tctgaatatg aaggcatggc gctgtcggac    660
aaggatatac tcgcactgat tcttaatgtg ctggttagccg caacggaacc ggctgataag    720
acgctggcac tgatgatcta ccatttgctc aacaatcctg agcagatgaa tgatgttttg    780
gctgaccggt cgtttagttcc gagagccatt gcggagacat tgcgttataa accgcccgtt    840
cagctgattc cgcggcagct gtcccaagat acagtggctg gcggtatgga aatcaaaaaa    900
gatacgattg ttttttgtat gatcgggtgcg gctaaccggg accctgaagc atttgaacag    960
```

cctgacgtgt ttaatattca tcggaagat cttggtatca agagcgcttt tagcgcgcc 1020
 gcccggcatc tcgctttcgg atccggcatt cataactgtg taggagcagc ttttgccaaa 1080
 aacgaaatcg aaattgtagc taatattgtg ctggataaga tgcggaatat cagattagag 1140
 gaagattttt gttatgctga gtccggtctg tatacacgcg gacctgtttc acttctcgtt 1200
 gcgtttgacg gggca 1215

<210> 2
 <211> 405
 <212> PRT
 <213> Bacillus subtilis

<400> 2

Met Ser Gln Ser Ile Lys Leu Phe Ser Val Leu Ser Asp Gln Phe Gln
 1 5 10 15

Asn Asn Pro Tyr Ala Tyr Phe Ser Gln Leu Arg Glu Glu Asp Pro Val
 20 25 30

His Tyr Glu Glu Ser Ile Asp Ser Tyr Phe Ile Ser Arg Tyr His Asp
 35 40 45

Val Arg Tyr Ile Leu Gln His Pro Asp Ile Phe Thr Thr Lys Ser Leu
 50 55 60

Val Glu Arg Ala Glu Pro Val Met Arg Gly Pro Val Leu Ala Gln Met
 65 70 75 80

His Gly Lys Glu His Ser Ala Lys Arg Arg Ile Val Val Arg Ser Phe
 85 90 95

Ile Gly Asp Ala Leu Asp His Leu Ser Pro Leu Ile Lys Gln Asn Ala
 100 105 110

Glu Asn Leu Leu Ala Pro Tyr Leu Glu Arg Gly Lys Ser Asp Leu Val
 115 120 125

Asn Asp Phe Gly Lys Thr Phe Ala Val Cys Val Thr Met Asp Met Leu
 130 135 140

Gly Leu Asp Lys Arg Asp His Glu Lys Ile Ser Glu Trp His Ser Gly

145

150

155

160

Val Ala Asp Phe Ile Thr Ser Ile Ser Gln Ser Pro Glu Ala Arg Ala
 165 170 175

His Ser Leu Trp Cys Ser Glu Gln Leu Ser Gln Tyr Leu Met Pro Val
 180 185 190

Ile Lys Glu Arg Arg Val Asn Pro Gly Ser Asp Leu Ile Ser Ile Leu
 195 200 205

Cys Thr Ser Glu Tyr Glu Gly Met Ala Leu Ser Asp Lys Asp Ile Leu
 210 215 220

Ala Leu Ile Leu Asn Val Leu Leu Ala Ala Thr Glu Pro Ala Asp Lys
 225 230 235 240

Thr Leu Ala Leu Met Ile Tyr His Leu Leu Asn Asn Pro Glu Gln Met
 245 250 255

Asn Asp Val Leu Ala Asp Arg Ser Leu Val Pro Arg Ala Ile Ala Glu
 260 265 270

Thr Leu Arg Tyr Lys Pro Pro Val Gln Leu Ile Pro Arg Gln Leu Ser
 275 280 285

Gln Asp Thr Val Val Gly Gly Met Glu Ile Lys Lys Asp Thr Ile Val
 290 295 300

Phe Cys Met Ile Gly Ala Ala Asn Arg Asp Pro Glu Ala Phe Glu Gln
 305 310 315 320

Pro Asp Val Phe Asn Ile His Arg Glu Asp Leu Gly Ile Lys Ser Ala
 325 330 335

Phe Ser Gly Ala Ala Arg His Leu Ala Phe Gly Ser Gly Ile His Asn
 340 345 350

Cys Val Gly Ala Ala Phe Ala Lys Asn Glu Ile Glu Ile Val Ala Asn
 355 360 365

Ile Val Leu Asp Lys Met Arg Asn Ile Arg Leu Glu Glu Asp Phe Cys

370

375

380

Tyr Ala Glu Ser Gly Leu Tyr Thr Arg Gly Pro Val Ser Leu Leu Val
 385 390 395 400

Ala Phe Asp Gly Ala
 405

<210> 3
 <211> 1218
 <212> DNA
 <213> Bacillus subtilis

<400> 3
 gtgtacactt tggctcatatc aaaatcaaag gcagtattga tcttatacac tgtttgcttc 60
 agtgcatttt ttgcatcttt aagccagaac atttattcac ctattcttcc gatcattaaa 120
 gaatcattcc atgtttccac agctatgggtg aacctgtcag tctcagtttt tatgattgtg 180
 acagcaataa tgcaaattat attaggagcg atcattgatt ttaaaggcgc tcggatcgtc 240
 ttgattaccg gtattctggc aacggcagca gccagcatcg gctgtgcggt gactactgac 300
 ttacacttgt ttctgatatt cagaatgata caggcagccg gttccgcagc actgcctctt 360
 attgctgcca caacgatcgg acagctgttt acaggaaatg aacgcgggag tgcaatggga 420
 acgtatcaaa tgctcctgtc tgcgcaccg gctattgctc cagttctagg aggattcata 480
 ggcggagcag ccggatacga agggattttt tggatacttg cggccatctc tatcgttttg 540
 ctggtgacaa acagcatcac ctttcctaaa gattctccaa ctgaatctat gcagcaagcc 600
 aaaggcaatg tgttcgtca ttataaatca atatttacia atcgaacagg gaacgtcatt 660
 ttgactttta gttttgttct ctttttcatt tttttgcag taattgtcta cctcccaata 720
 ttgctgacag agcattacca tatagatgtg ggtatagcag gactgttata tttgccgctg 780
 gcgctgagca cgattgcagg tacgtttctg tttaaaagaa tacaggcaaa aatcgggctg 840
 cacaccttgt ttatcggaag caatgtgatt gccgcctgca gcatcatttt atttgcgtgt 900
 acacattccg tttctctcgt tctcatggct ctgacgctgg cactgtttgg catctcgatg 960
 ggggttattc ctcccttgta ctctacaatg attactaatg aatttgagca caacagaggg 1020
 agtgcaatcg gaatgtttta ctttatccga tatacaggca tggcagcagg tccgatggta 1080
 tctgcctact tgctcacaat gatgccgtct gccatgtcct ttagcctcct aggccttgga 1140
 tttgccgcat tgagcttttg cttctctccg ccaatgtttt cgccgcagaa gcgcacgaaa 1200

caaaaaaagc accacatg

1218

<210> 4
<211> 406
<212> PRT
<213> Bacillus subtilis

<400> 4

Met Tyr Thr Leu Ala His Thr Lys Ser Lys Ala Val Leu Ile Leu Tyr
1 5 10 15

Thr Val Cys Phe Ser Ala Phe Phe Ala Ser Leu Ser Gln Asn Ile Tyr
20 25 30

Ser Pro Ile Leu Pro Ile Ile Lys Glu Ser Phe His Val Ser Thr Ala
35 40 45

Met Val Asn Leu Ser Val Ser Val Phe Met Ile Val Thr Ala Ile Met
50 55 60

Gln Ile Ile Leu Gly Ala Ile Ile Asp Phe Lys Gly Ala Arg Ile Val
65 70 75 80

Leu Ile Thr Gly Ile Leu Ala Thr Ala Ala Ala Ser Ile Gly Cys Ala
85 90 95

Val Thr Thr Asp Phe Thr Leu Phe Leu Ile Phe Arg Met Ile Gln Ala
100 105 110

Ala Gly Ser Ala Ala Leu Pro Leu Ile Ala Ala Thr Thr Ile Gly Gln
115 120 125

Leu Phe Thr Gly Asn Glu Arg Gly Ser Ala Met Gly Thr Tyr Gln Met
130 135 140

Leu Leu Ser Val Ala Pro Ala Ile Ala Pro Val Leu Gly Gly Phe Ile
145 150 155 160

Gly Gly Ala Ala Gly Tyr Glu Gly Ile Phe Trp Ile Leu Ala Ala Ile
165 170 175

Ser Ile Val Leu Leu Val Thr Asn Ser Ile Thr Phe Pro Lys Asp Ser

180

185

190

Pro Thr Glu Ser Met Gln Gln Ala Lys Gly Asn Val Phe Ala His Tyr
 195 200 205

Lys Ser Ile Phe Thr Asn Arg Thr Gly Asn Val Ile Leu Thr Leu Ser
 210 215 220

Phe Val Leu Phe Phe Ile Tyr Phe Ala Val Ile Val Tyr Leu Pro Ile
 225 230 235 240

Leu Leu Thr Glu His Tyr His Ile Asp Val Gly Ile Ala Gly Leu Leu
 245 250 255

Tyr Leu Pro Leu Ala Leu Ser Thr Ile Ala Gly Thr Phe Leu Phe Lys
 260 265 270

Arg Ile Gln Ala Lys Ile Gly Leu His Thr Leu Phe Ile Gly Ser Asn
 275 280 285

Val Ile Ala Ala Cys Ser Ile Ile Leu Phe Ala Val Thr His Ser Val
 290 295 300

Ser Leu Val Leu Met Ala Leu Thr Leu Ala Leu Phe Gly Ile Ser Met
 305 310 315 320

Gly Val Ile Pro Pro Leu Tyr Ser Thr Met Ile Thr Asn Glu Phe Glu
 325 330 335

His Asn Arg Gly Ser Ala Ile Gly Met Phe Asn Phe Ile Arg Tyr Thr
 340 345 350

Gly Met Ala Ala Gly Pro Met Val Ser Ala Tyr Leu Leu Thr Met Met
 355 360 365

Pro Ser Ala Met Ser Phe Ser Leu Leu Gly Leu Gly Phe Ala Ala Leu
 370 375 380

Ser Phe Cys Leu Leu Pro Pro Met Phe Ser Pro Gln Lys Arg Thr Lys
 385 390 395 400

Gln Lys Lys His His Met

405

<210> 5
 <211> 507
 <212> DNA
 <213> Bacillus subtilis

<400> 5
 atgtctgatt tgacaaaaca gatgatatac gacatatacg tgagactgct gcaccttaat 60
 gaacaaaaag cgaacacttc acttcagcaa ttttttaagg aggccgcaga agaggatgta 120
 gctgaaattc ccaaaaatat gacaagcatt cacgtcattg actgcatcgg ccagcatgaa 180
 cccattaata atgccggaat tgccagaaaa atgaacttat cgaaagcgaa tgtaacgaaa 240
 atcagcacaa aactgatcaa ggaagaattc attaacagct atcagctgac agataacaaa 300
 aaagaagttt attttaaatt aacccgtaaa ggcagacgga ttttcgactt acatgagaaa 360
 ctgcataaaa aaaaggagct ggctttttac caattcctcg attcattttc acaagaagaa 420
 caaaaggctg tattgaagtt tctagagcag ttgacgtcaa cacttgaagc agaacaaacc 480
 gatgggactc cagacaaacc tgtaaag 507

<210> 6
 <211> 169
 <212> PRT
 <213> Bacillus subtilis

<400> 6
 Met Ser Asp Leu Thr Lys Gln Met Ile Tyr Asp Ile Tyr Val Arg Leu
 1 5 10 15
 Leu His Leu Asn Glu Gln Lys Ala Asn Thr Ser Leu Gln Gln Phe Phe
 20 25 30
 Lys Glu Ala Ala Glu Glu Asp Val Ala Glu Ile Pro Lys Asn Met Thr
 35 40 45
 Ser Ile His Val Ile Asp Cys Ile Gly Gln His Glu Pro Ile Asn Asn
 50 55 60
 Ala Gly Ile Ala Arg Lys Met Asn Leu Ser Lys Ala Asn Val Thr Lys
 65 70 75 80
 Ile Ser Thr Lys Leu Ile Lys Glu Glu Phe Ile Asn Ser Tyr Gln Leu

85

90

95

Thr Asp Asn Lys Lys Glu Val Tyr Phe Lys Leu Thr Arg Lys Gly Arg
 100 105 110

Arg Ile Phe Asp Leu His Glu Lys Leu His Lys Lys Lys Glu Leu Ala
 115 120 125

Phe Tyr Gln Phe Leu Asp Ser Phe Ser Gln Glu Glu Gln Lys Ala Val
 130 135 140

Leu Lys Phe Leu Glu Gln Leu Thr Ser Thr Leu Glu Ala Glu Gln Thr
 145 150 155 160

Asp Gly Thr Pro Asp Lys Pro Val Lys
 165

<210> 7
 <211> 753
 <212> DNA
 <213> Bacillus subtilis

<400> 7
 gtgaatgaga tgaccggaat ggtaacggaa agaaggctctg tgcattttat tgctgaggca 60
 ttaacagaaa actgcagaga aatatttgaa cggcgcaggc atgttttggt ggggatcagc 120
 ccatttaaca gcaggttttc agaggattat atttacagat taattggatg ggcgaaagct 180
 caatttaaaa gcgtttcagt tttacttgca gggcatgagg cggctaactc tctagaagcg 240
 cttggaactc cgagaggaaa ggctgaacga aaagtaagga aagaggatc acgaaacagg 300
 agatttgag aaagagccct tgtggctcat ggcggggatc cgaaggcgat tcatacattt 360
 tctgatttta tagataacaa agcctaccag ctgttgagac aagaagttga acatgcattt 420
 tttgagcagc ctcattttcg acatgcttgt ttggacatgt ctctgaagc gataatcggg 480
 cgtgcgcggg gcgtcagttt gatgatggaa gaagtcagtg aggatatgct gaatttggt 540
 gtggaatatg tcatagctga gctgccgttt tttatcggag ctccggatat tttagaggtg 600
 gaagagacac tccttgctta tcctgctccg tggaagctgg gtgagaagat cagtaaccat 660
 gaattttcta tttgtatgcg gccgaatcaa gggatatctca ttgtacagga aatggcgcag 720
 atgctttctg agaaacggat cacatctgaa gga 753

<210> 8
 <211> 251
 <212> PRT
 <213> Bacillus subtilis

<400> 8

Met Asn Glu Met Thr Gly Met Val Thr Glu Arg Arg Ser Val His Phe
 1 5 10 15

Ile Ala Glu Ala Leu Thr Glu Asn Cys Arg Glu Ile Phe Glu Arg Arg
 20 25 30

Arg His Val Leu Val Gly Ile Ser Pro Phe Asn Ser Arg Phe Ser Glu
 35 40 45

Asp Tyr Ile Tyr Arg Leu Ile Gly Trp Ala Lys Ala Gln Phe Lys Ser
 50 55 60

Val Ser Val Leu Leu Ala Gly His Glu Ala Ala Asn Leu Leu Glu Ala
 65 70 75 80

Leu Gly Thr Pro Arg Gly Lys Ala Glu Arg Lys Val Arg Lys Glu Val
 85 90 95

Ser Arg Asn Arg Arg Phe Ala Glu Arg Ala Leu Val Ala His Gly Gly
 100 105 110

Asp Pro Lys Ala Ile His Thr Phe Ser Asp Phe Ile Asp Asn Lys Ala
 115 120 125

Tyr Gln Leu Leu Arg Gln Glu Val Glu His Ala Phe Phe Glu Gln Pro
 130 135 140

His Phe Arg His Ala Cys Leu Asp Met Ser Arg Glu Ala Ile Ile Gly
 145 150 155 160

Arg Ala Arg Gly Val Ser Leu Met Met Glu Glu Val Ser Glu Asp Met
 165 170 175

Leu Asn Leu Ala Val Glu Tyr Val Ile Ala Glu Leu Pro Phe Phe Ile
 180 185 190

Gly Ala Pro Asp Ile Leu Glu Val Glu Glu Thr Leu Leu Ala Tyr His

195

200

205

Arg Pro Trp Lys Leu Gly Glu Lys Ile Ser Asn His Glu Phe Ser Ile
 210 215 220

Cys Met Arg Pro Asn Gln Gly Tyr Leu Ile Val Gln Glu Met Ala Gln
 225 230 235 240

Met Leu Ser Glu Lys Arg Ile Thr Ser Glu Gly
 245 250

<210> 9
 <211> 18
 <212> DNA
 <213> Bacillus subtilis

<400> 9
 catgggagag acctttgg

18

<210> 10
 <211> 17
 <212> DNA
 <213> Bacillus subtilis

<400> 10
 gtcggtcttc catttgc

17

<210> 11
 <211> 17
 <212> DNA
 <213> Bacillus subtilis

<400> 11
 cgaccactgt atcttgg

17

<210> 12
 <211> 17
 <212> DNA
 <213> Bacillus subtilis

<400> 12
 gagatgccaa acagtgc

17

<210> 13
 <211> 16
 <212> DNA
 <213> Bacillus subtilis

<400> 13	
catgtccatc gtgacg	16
<210> 14	
<211> 17	
<212> DNA	
<213> Bacillus subtilis	
<400> 14	
caggagcatt tgatacg	17
<210> 15	
<211> 16	
<212> DNA	
<213> Bacillus subtilis	
<400> 15	
ccttcagatg tgatcc	16
<210> 16	
<211> 17	
<212> DNA	
<213> Bacillus subtilis	
<400> 16	
gtgttgacgt caactgc	17
<210> 17	
<211> 18	
<212> DNA	
<213> Bacillus subtilis	
<400> 17	
gttcagcctt tcctctcg	18
<210> 18	
<211> 18	
<212> DNA	
<213> Bacillus subtilis	
<400> 18	
gctaccttct ttcttagg	18
<210> 19	
<211> 18	
<212> DNA	
<213> Bacillus subtilis	
<400> 19	
cgtcaatatg atctgtgc	18

<210> 20
<211> 17
<212> DNA
<213> Bacillus subtilis

<400> 20
ggaaagaagg tctgtgc

17

<210> 21
<211> 17
<212> DNA
<213> Bacillus subtilis

<400> 21
cagctatcag ctgacag

17

<210> 22
<211> 20
<212> DNA
<213> Bacillus subtilis

<400> 22
gctcagctat gacatattcc

20

<210> 23
<211> 17
<212> DNA
<213> Bacillus subtilis

<400> 23
gatcgtcttg attaccg

17

<210> 24
<211> 16
<212> DNA
<213> Bacillus subtilis

<400> 24
agctttatcg gtgacg

16

<210> 25
<211> 16
<212> DNA
<213> Bacillus subtilis

<400> 25
tgagcacgat tgcagg

16

<210> 26
<211> 17
<212> DNA
<213> Bacillus subtilis

<400> 26
cattgcggag acattgc

17

<210> 27
<211> 26
<212> DNA
<213> Bacillus subtilis

<400> 27
tagacaattg gaagagaaaa gagata

26

<210> 28
<211> 20
<212> DNA
<213> Bacillus subtilis

<400> 28
ccgtcgctat tgtaaccagt

20

<210> 29
<211> 18
<212> DNA
<213> Bacillus subtilis

<400> 29
catgggagag acctttgg

18

<210> 30
<211> 24
<212> DNA
<213> Bacillus licheniformis

<400> 30
gaattcgcag gaggaacgag tatg

24

<210> 31
<211> 24
<212> DNA
<213> Bacillus licheniformis

<400> 31
aagcttgaag atcagtgagg cagc

24